Note.—The application for a Patent has become void.
This print shows the Specification as it became open to public inspection under Section 91 (3) (a) of the Acts.

PATENT SPECIFICATION

Convention Date (France): Nov. 22, 1927. **300,983**
Application Date (in United Kingdom): Nov. 12, 1928. No. 33,076 / 28.
Complete not Accepted.

COMPLETE SPECIFICATION.

Improvements in Processes for the Assembling of Mechanical and other Parts by Bolts or Screws.

I, Hugues Louis Dardelet, a citizen of the French Republic, of 5, Rue Menou, Nantes, Loire-Inférieure, France, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

When it is desired to assemble two mechanical pieces in such manner that they may be separated at will, it is the common practice to employ bolts or screws which are engaged in corresponding holes in the two pieces and which are threaded or plain according as screws or bolts are employed. Fig. 1 represents a connection by bolts, and the two pieces A—B are joined by the two bolts C—D.

The holes containing the shanks of the bolts are in all cases given a larger diameter than that of the said shanks, to provide for a ready assembling, and in this event the two pieces A—B are connected together by an effort of friction which is equal to the effort of pressure of the bolts multiplied by the coefficient of friction of the surfaces in contact s s^1, or F f. If the pieces are subjected in the plane of the surfaces s s^1 to active and resistant efforts which exceed F f, the pieces will move relatively to one another by the quantity allowed by the play between the shanks of the bolts and the walls of the holes, and the device will assume the position shown in Fig. 2 in a very exaggerated manner, Fa being the active effort and Fr the resistant effort.

The pieces are thus brought together in the direction of the effort Fa by the resistance to the shearing of the bolt according to the cross sections m n and m^1 n^1; since at the time of the contact the surfaces of m and n, and of m^1 and n^1 are small, these will yield and will be flattened, and the same prevails for all the other possible points of contact s s^1, p, p^1, q q^1. This flattening will only cease when the area of the flattened surfaces allows the efforts Fa and Fr to be supported without permanent deformation.

This tipping of the bolts causes a great effort of elongation to be set up according to the axis, and this may have an infinite value in the first place, so that nothing will prevent the bolt from tipping, from lengthening, or from flattening the surfaces of contact with the head of the bolt and of the nut, at p q, p^1 q^1.

If the efforts Fa and Fr change their direction, which is often the case, the bolts will tip in the other direction, and with greater facility according as the initial effort of friction which holds the pieces is reduced by the flattening of the contact parts or the lengthening of the bolts. In this manner the pieces will not be constantly joined, so that the shocks produced during the relative alternate displacement of the pieces will cause damage to the said pieces as well as to the shanks of the bolts, and the threads, and the nuts will finally become loosened.

To obviate all such defects, I have devised improvements in these methods of assembling, which form the subject-matter of the present invention and will be specified in the following description with reference to the appended drawings which are given by way of example.

The surfaces s s^1 of the pieces are no longer flat, but are given a sinuous form, for instance by the use of parallel corrugations whose edges are perpendicular to the direction of the efforts Fa and Fr and whose section on a plane perpendicular to the edges forms angles of a greater or less value. The said corrugations have a sufficient width, and they fit into one another as shown in Fig. 3.

When the pieces are pressed together

by the bolts with an effort F, if the angle of the edges is made 60 degrees (Fig. 4) the total pressure on the surface of the corrugations is 2F.

If the piece A is subjected to an active effort Fa and the piece B is hence given a resistant effort $Fr = -Fa$:

(1) the effort tending to lengthen the bolt will be Fa tan 30°;

(2) the pressure upon the contact surfaces of the corrugations is $\frac{Fa}{\cos 30^\circ}$.

In this event, the efforts Fa can only change the assembling of the pieces in a permanent manner when Fa is greater than F : tan 30° and only when F is the effort for which the bolt attains the elastic limit, and when Fa : cos 30° is greater than ER_e, in which E is 1/2 the total contact surface of the corrugations and R_e the value of the resistance of the material at the elastic limit, and when Fa will overcome the shearing resistance of the corrugations, that is, when Fa is greater than $\frac{ER_e^1}{2}$ R_e^1 being the shearing resistance at the elastic limit. This latter condition renders the second condition useless

$$\left(\frac{Fa}{\cos 30^\circ} > ER_e\right).$$

In short, there are two conditions to be fulfilled in order to provide for the constant assembling of the pieces, or:

$$Fa < \frac{F}{\tan 30^\circ}$$

$$Fa < \frac{ER_e^1}{2}$$

The conditions may be made such that

$$\frac{F}{\tan \alpha} = \frac{ER_e^1}{2}.$$

To afford concrete ideas as to the above, and to compare the resistances offered by the known assembling method (Fig. 1) and my said method, I will specify certain dimensions for the pieces A—B and the bolts C—D.

A and B are simple pieces of flat iron of rectangular section of 20 by 60 mm. which are in contact upon 100 mm. and are assembled by 20 mm. bolts. The said pieces and bolts have a breaking strain of 40 kgs. per sq. mm. (ordinary soft steel).

The bolts attain their elastic limit for an axial effort of: section at the bottom of the thread $\times R_e$, in which $R_e = 25$ kgs., or for one bolt, 5500 kgs. This is the maximum screwing pressure which can be used with a bolt of this size. For two bolts, the value is 11,000 kgs.

In the known method, admitting that f is 0.25, Fa will always be smaller than $11{,}000 \times 0.25 = 2.750$ kgs.

In my said device according to Figure 2, since the screwing pressure of the bolts is 11,000 kgs., Fa must be less than 11,000 : tan 30° or 11,000 : 0.57 = 19.298 kgs.

The resistance of the corrugations to shearing stress is thus 60,000 kgs. Due to their section, the pieces cannot support more than 30,000 kgs.

In the case under consideration, there will be no change in the connection between the pieces except when the efforts exceed 2750 kgs. with the known device, and 19,298 kgs. with my said device.

It has been supposed that the pieces A and B are of the same material, but in certain industries, (such as the weaving industry), it is often required to assemble pieces of different material having very different resistances, for instance steel or cast iron with wood.

The piece A may for example consist of cast iron and the piece B of wood. The said pieces have the same size as in the preceding case, except for the thickness, which for A is 10 mm. and for B 30 mm.

The pieces are assembled by 12 mm. bolts. The pressure of said bolts (of steel at 40 kgs.—elastic limit 25 kgs. per sq. mm.) is at the elastic limit 1.800 kgs.

If a thick washer e^1 whose diameter is 24 mm. is placed under the nut, it will be possible to use a pressure of only 1000 kgs., since the wood will yield.

If the screwing of the two bolts gives 2000 kgs. pressure, the assembling of the parts will be assured as long as one does not obtain an effort Fa which exceeds $2000 \times 0.25 = 500$ kgs.

With this device, the limiting values of Fa are 3500 kgs. with formula 1 and 1500 kgs. with formula 2. These values can be increased by increasing the contact surfaces of the pieces and diminishing the angle of the edges. In the known method, the resistance can only be increased by increasing the screw pressure. In the above-mentioned case, this is of no interest, since the wood pieces cannot support more than 900 kgs.

The essential feature of the invention consists in the fact that the contact surfaces of the assembled pieces, instead of consisting as usual of planes formed by straight lines as generatrices, consist of surfaces formed by sinuous lines comprising straight lines portions placed at an angle as shown in Fig. 4 or connected by curved lines as shown in Fig. 5, or by curved portions in alternate disposition as shown in Fig. 6. These generatrices have a regular form as shown in Figs. 4, 5 and 6, or an irregular form as shown in Fig. 7. They may be constant or not, while the said surfaces are being formed,

and the surfaces may be produced by the use of any suitable directing lines such as straight lines, circumferences or curves of any kinds, and according to any desired rule. The only condition is that all such surfaces will exactly fit together when in contact.

In short, the corrugations may be given any suitable sections and outlines, and may be disposed according to any desired patterns. They may even be replaced by securing means consisting of recesses and bosses of any kind, or more generally by male and female parts fitting together, with the sole condition that the two surfaces shall exactly fit together when in contact.

By way of example, and without limitation, Figs. 8 to 13 show plan views of the various contact surfaces which may be employed.

Fig. 8 represents parallel corrugations whose outline is that of Figures 3 and 4, in section on the line *a—b*.

Fig. 9 shows corrugations whose direction changes according to the lines *c—d* and *e—f*, the outline being the same, in section across the ridges.

Fig. 10 shows concentric corrugations, with the same outline in section through the centres o and o^1.

Fig. 11 shows straight cones whose vertices are situated at g, these being in high relief on one surface and in hollow relief on the other.

Fig. 12 represents truncated pyramids with square base, in high relief on one surface and in hollow relief on the other.

Fig. 13 shows corrugations with sharp edges, having any suitable shapes and directions.

Obviously, a proper choice will be made of surfaces which can be readily produced, while offering satisfactory conditions as regards strength. As a rule, I may thus employ those shown in Figs. 3, 4 and 8 when the efforts Fa have a practically constant direction, and those shown in Figs. 10 and 11 when the efforts Fa have a variable direction. Such surfaces may be formed by casting, and can be eventually trimmed if desired.

The improved method of assembling can be employed for a great variety of purposes, since this method can be adopted in all cases in which pieces bolted together are subjected to stresses or shocks which may overcome the resistance due to the pressure of the bolts and the friction of the pieces.

Among the uses of the said method, I may mention two which are particularly advantageous.

A.—Fish plates for rails, with insulating joint.

Such plates are employed in electric railways, and by their use, two rails may be mechanically joined while being electrically insulated. At the present time, the plates have the form shown in Fig. 14.

The metallic plates H and J are secured by the bolts K and L to the rails P and Q, on each side of the rails. These two plates are connected together by insulated bolts, by the flanges N and the fibre washers M M^1. A fibre plate is also disposed between the two flanges at R.

This case corresponds to the one shown in Fig. 1, but with the interposition of insulating pieces, and the parts H and J are only connected together due to the effort of pressure of the bolts multiplied by the coefficient of friction of the pieces upon the fibre.

In these conditions, when a train passes, all the efforts due to the loads or shocks brought upon one of the pieces and exceeding 9 tons (admitting a friction coefficient of 0,25) will necessarily cause a relative movement of the pieces, even if the bolts have been tightened as far as the elastic limit.

By the use of my said device, the arrangement has the form shown in Fig. 15 in side view, in Fig. 16 in end view, and in Fig. 17 in plan view. The same letters are used as in Fig. 14 to represent like parts. The contact surface of the pieces may have the corrugated form shown in Figs. 3 and 4, this being shown in Fig. 15 and also in front view in Fig. 16 in the rear of the part broken away, the corrugations being horizontal when the piece is in position.

The fibre plate R^1 should be somewhat thin in order that the corrugations on the opposite sides of the parts N and N^1 shall be partially engaged in one another in spite of the use of the said fibre plate.

In these conditions, a load of about 50 tons may travel over the rail without any relative motion of the parts 4 and 5, and without disconnecting these parts, as takes place with the known device.

B.—In weaving machines, wood pieces are connected to cast iron pieces by bolts, and these are subjected to violent shocks, these being the picking stick and the long treadle.

Fig. 18 is a side view of the known type of picking stick which consists of a wood strip h fitted into and bolted upon a right-angled cast iron shoe i, suitably pivoted, termed picking stick box. Upon the pointed end j of the said box is caused to strike the end of the long treadle k which is shown in Fig. 19 and consists of a thick wood strip which is secured by bolts at its lower end to a cast iron holder t termed long treadle box, and carries a cast iron

angle-piece u termed lay tappet, which is acted upon by the controlling cam and is bolted to the said long treadle.

Fig. 18ᵃ is a section on the line x—x of Fig. 18.

Figs. 19ᵃ and 19ᵇ are sections on the lines y—y and z—z of Fig. 19, respectively.

In conformity to the invention, the assembling of the parts forming the picking stick and the long treadle is effected as shown in Figs. 20 and 20ᵃ for the picking stick, and as shown in Figs. 21, 21ᵃ and 21ᵇ for the long treadle, the sections being made at the same heights as in Figs. 18 and 19.

By the use of my said process as described, the inside part t^2 of the picking stick box t^1, is not smooth but is corrugated as shown in Figs. 20ᵃ and 4, and in like manner the picking stick h^1 is corrugated at the part in contact with the said box, and its corrugations fit into those of the said box as shown in Figs. 20 and 20ᵃ.

Furthermore, in order to increase the surfaces of contact between the picking stick and its box, the said box carries a cover v which is also corrugated and its corrugations fit into those of the picking stick formed on the other face.

In this event, the device has the form represented in Figs. 20 and 20ᵃ.

The corrugations extend in the direction of the greatest length of the piece, the direction of the efforts being substantially perpendicular to this greatest length.

In like manner, in order to apply my said process, I give to the long treadle box t^1 and to the said lay tappet u^1 the form shown in Figs. 21, 21ᵃ and 21ᵇ.

The corrugations, which may have the form and pattern shown in Fig. 3, are perpendicular to the greatest length of the long treadle.

The long treadle box may be provided with a cover in order to increase the surface of contact.

In like manner, and for the same reason, the lay tappet may be provided with a second plate applied upon the wood and connected to the first plate by corrugations.

The wood piece of the long treadle is provided at the place at which are secured the box and the lay tappet with suitable corrugations corresponding to those of the cast iron pieces.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. Improvements in the method of assembling pieces of bolts or screws, characterised by the fact that the surfaces in contact offer parts in relief or male parts, and parts in sunken relief or female parts which correspond to one surface and the other, in such manner that when pressed together by bolts or screws, the male parts of one of the surfaces will enter and fit into the female parts of the other, and inversely.

2. Methods of realisation of the process for assembling by bolts or screws as claimed in claim 1, characterised by the fact that the male and female parts are constituted either by corrugations of any form and direction with or without sharp ridges, which may be parallel or concentric or not; or by straight male and female cones; or by truncated pyramids with square base or other, male and female.

3. A form of execution of the process claimed in claim 1, in which an intermediate plate or element forming a joint or not is inserted between the faces of the pieces to be assembled, said plate or element having on both faces corrugations or parts in relief and in hollow which are adapted to fit into the corrugations or parts in relief and in hollow of the faces of the said pieces between which it is held.

4. The application of the process claimed in claims 1 to 3, for the obtainment of fish plates or connections for rails with insulating joint, characterised by the fact that the plate of fibre, which forms a joint between the pieces or jaws, has corrugations which are horizontal when the connection is in place, the contact faces of the said pieces or jaws being provided with corresponding corrugations so as to fit into those of the said plate, (the said plate is preferably thin enough to effect the engagement of the male and female parts of the two pieces, in spite of the presence of the plate).

5. The application of the process claimed in claims 1 to 3 for the obtainment of pieces of weaving machines, such as picking sticks and long treadles and more generally pieces formed of elements of different materials such as wrought and cast iron, characterised by the fact that the said elements (such as picking sticks, picking stick boxes, long treadles, long treadle boxes and lay tappets) have corrugations or parts in hollow or in projection fitting into one another.

6. As manufactured products, the pieces, metallic or not, adapted to be assembed by bolts or screws, and whose surfaces in contact have corrugations and more generally parts sunken or raised, which are adapted to fit together when pressed, pieces such as elements of fish plates or connections of rails with insulating joint, picking

sticks and long treadles of weaving machines, and the like.

Dated this 12th day of November, 1928.

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Fig.1

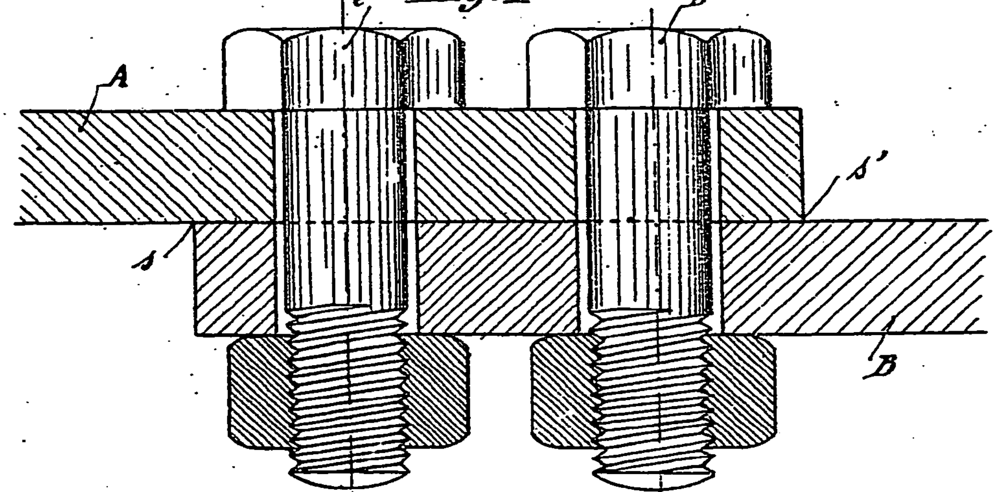


Fig.2

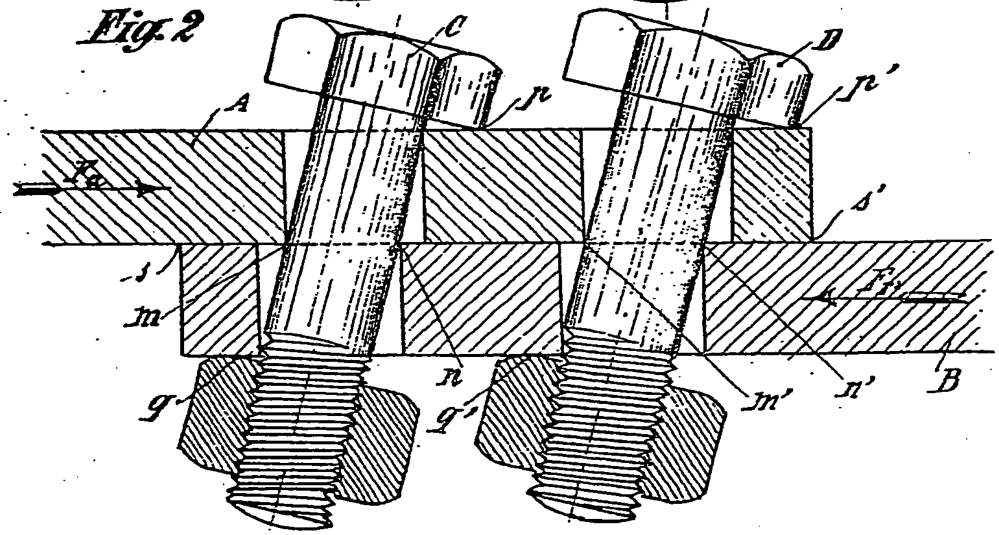
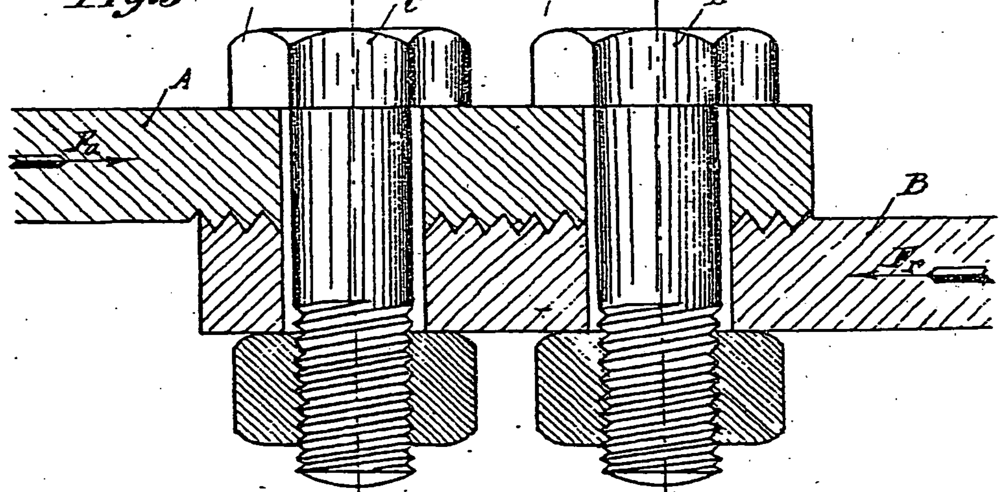


Fig.3



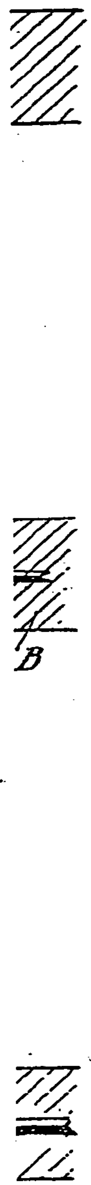


Fig.4

Fig.5

Fig.6

Fig.7

Fig.8

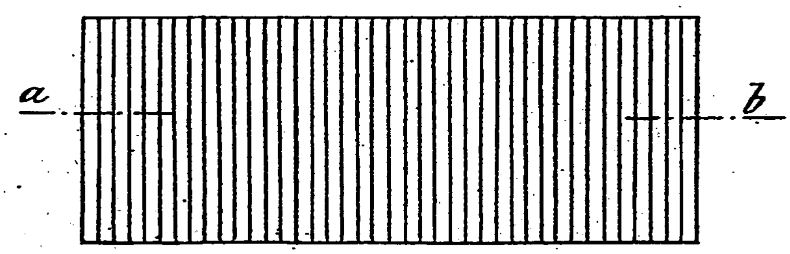
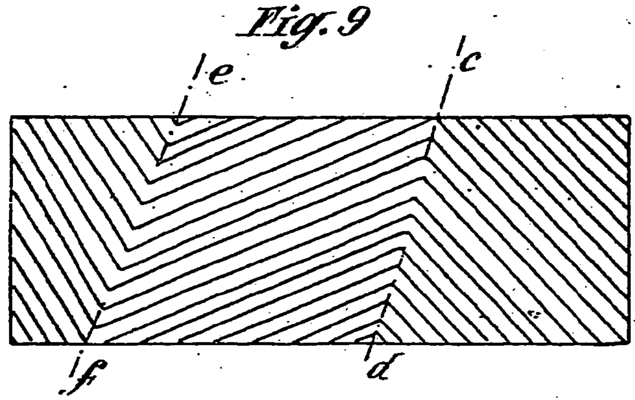


Fig.9



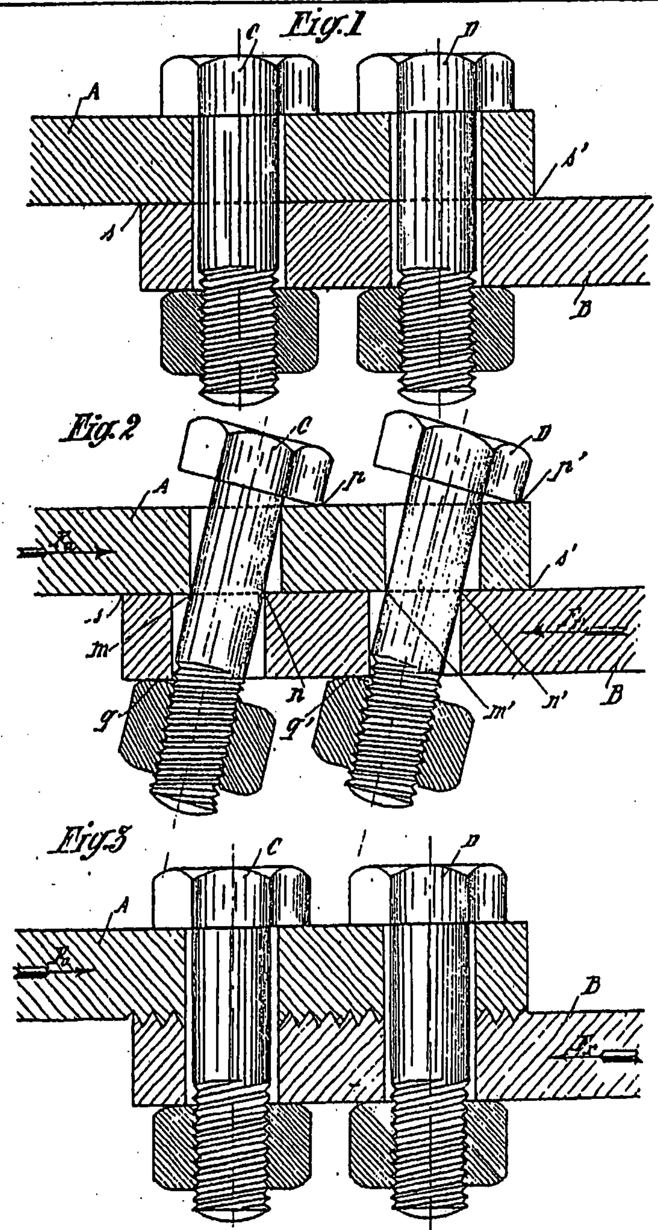


Fig.1
A
B
C
D
s
s'
Fig.2
A
B
C
D
m
m'
n
n'
q
q'
Fig.3
A
B
C
D

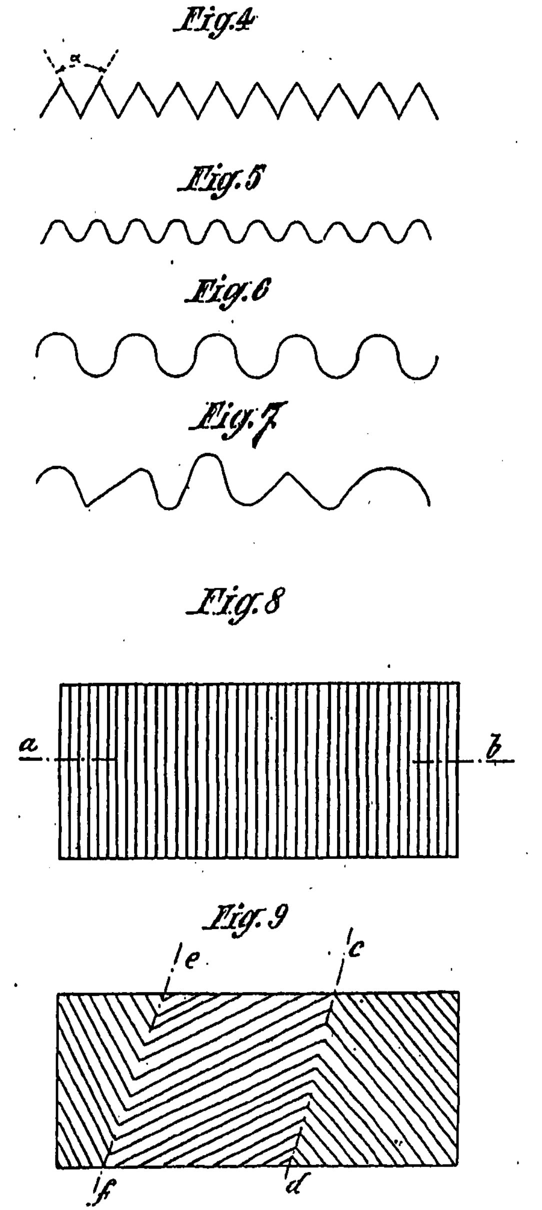


Fig.4
α
Fig.5
Fig.6
Fig.7
Fig.8
a
b
Fig.9
c
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e
f

Fig. 10

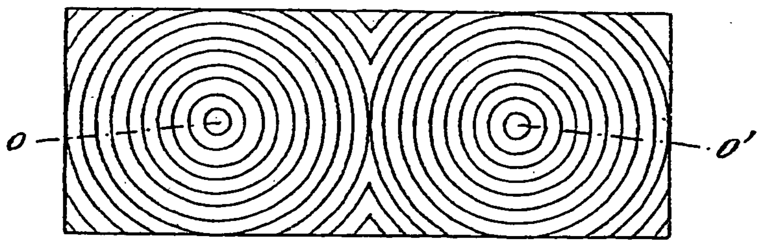

Fig. 11

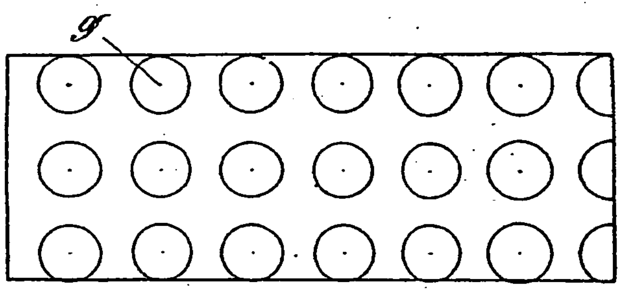

Fig. 12

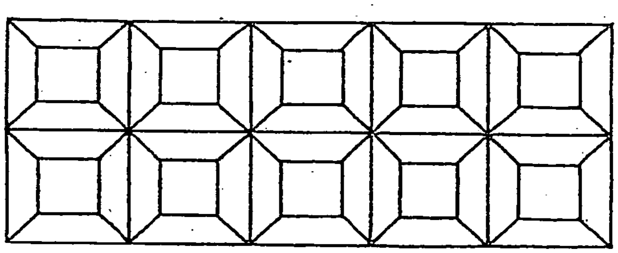

Fig. 13

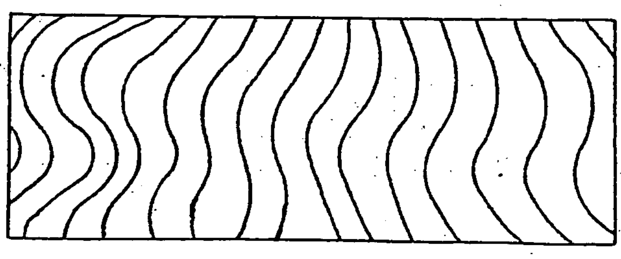

Fig. 14

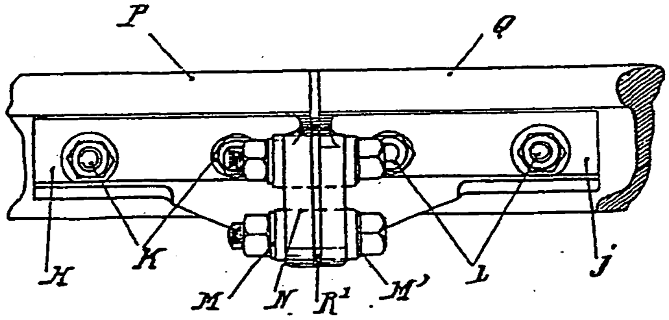

Fig. 15

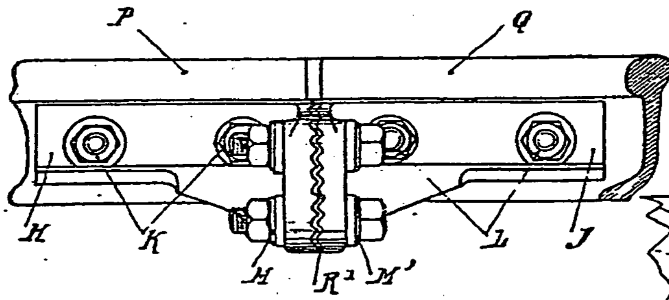

Fig. 16

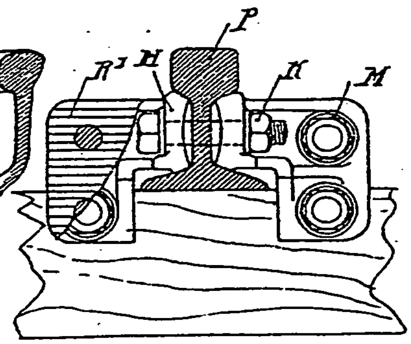

Fig. 17

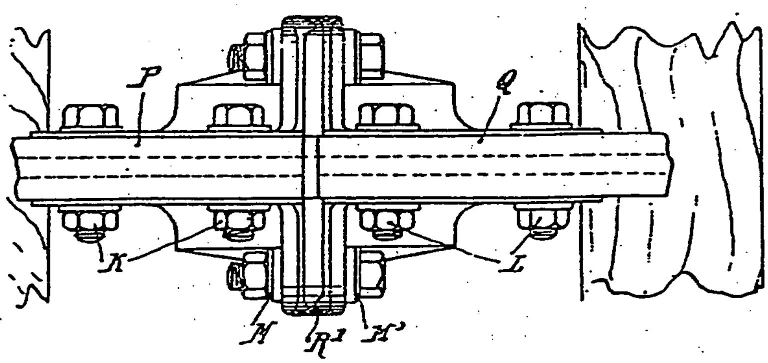

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Fig.10

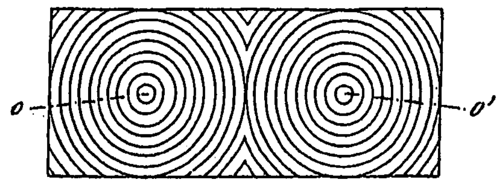


Fig.11

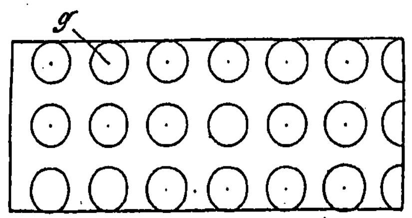


Fig.12

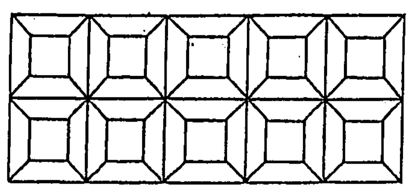


Fig.13

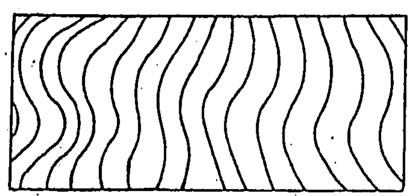


Fig.14

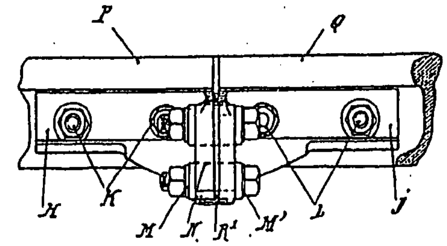


Fig.15

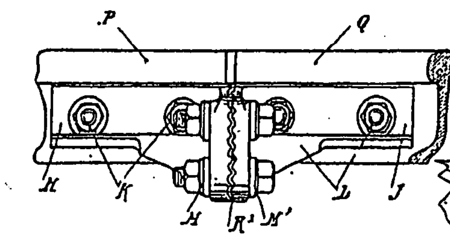


Fig.16

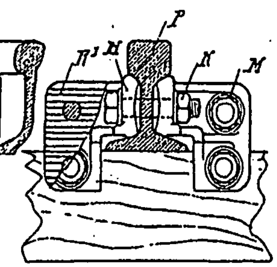
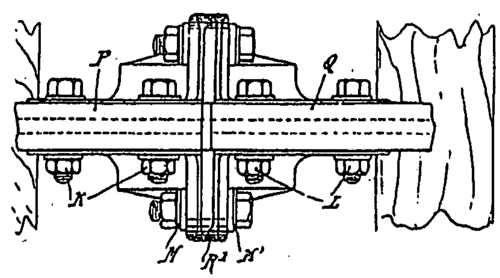


Fig.17



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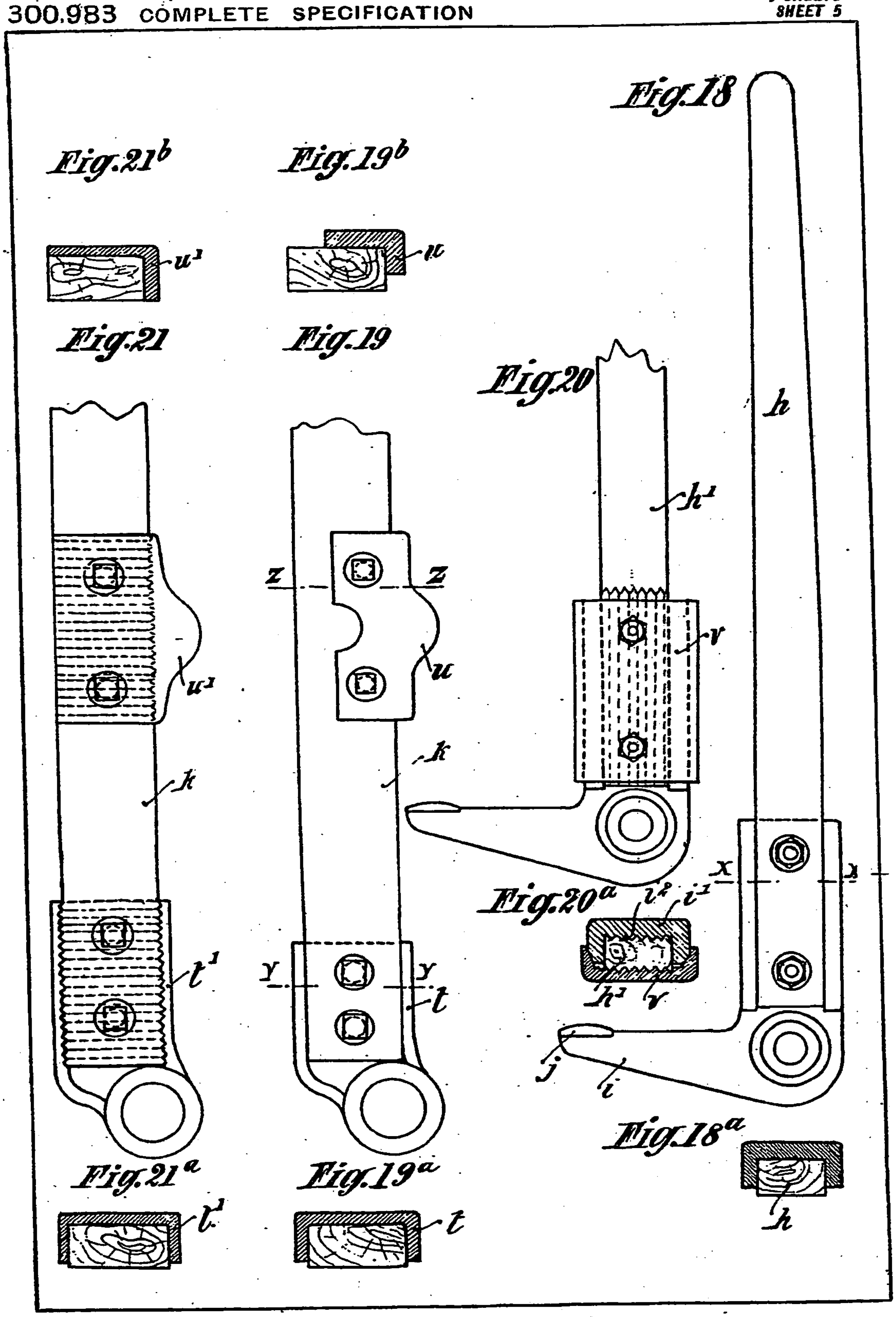

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